JAPANESE PATENT OFFICE
PATENT JOURNAL (A)
KOKAI PATENT APPLICATION NO. P2001-63325A

Int. Cl.[7]:	B 60 C 19/00 B 29 C 33/02 35/02 B 60C 15/00 23/04 B 60C 23/20 // B 29 K 21:00 105:24 B 29 L 30:00
Filing No.:	Hei 11[1999]-240736
Filing Date:	August 27, 1999
Publication Date:	March 13, 2001
No. of Claims:	10 (Total of 9 pages; OL)
Examination Request:	Not filed

PNEUMATIC TIRE WITH EMBEDDED TRANSPONDER AND MANUFACTURING METHOD THEREOF

Inventor:	Hirokatsu Maruyama Hiratsuka Works, The Yokohama Rubber Co., Ltd. 2-1 Oiwake, Hiratsuka-shi, Kanagawa-ken
Applicant:	000006714 The Yokohama Rubber Co., Ltd. 5-36-11 Shinbashi, Minato-ku, Tokyo

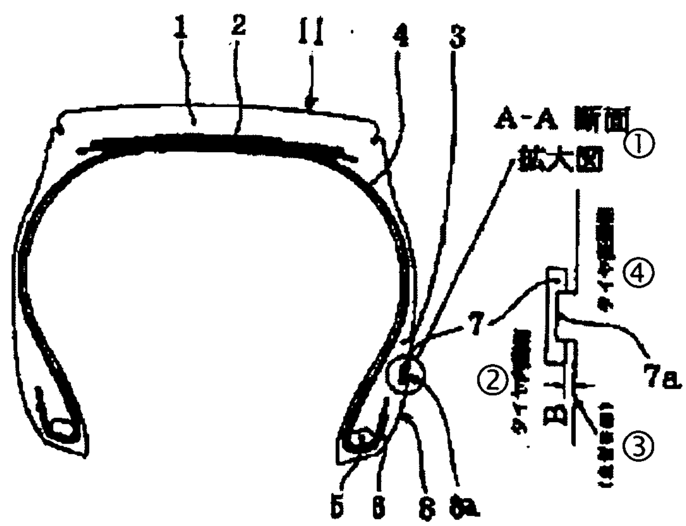
[There are no amendments to this patent.]

<u>Abstract</u>

Purpose

To provide a pneumatic tire with embedded transponder, which can reliably read, write, and store various information, and which has excellent robustness during vehicle travel, and the manufacturing method therefore.

Constitution: The pneumatic tire is characterized by the fact that a resin-coated transponder embedded in the tire bead no more than 100 mm from the level of the rim flange in the radially outward direction of the tire, and that part of said transponder is exposed in a recess in the tire bead surface, as well as a method for manufacturing the pneumatic tire in which a cavity or through-hole in the above-mentioned transponder is fitted to a projection installed on the surface mold, the unvulcanized tire is placed in the mold, and it is vulcanized.



Key:

Key:	1	Enlarged detail of cross section A-A
	2	Inner surface of tire
	3	Mold surface
	4	Outside surface of tire

<u>Claims</u>

1. A pneumatic tire, characterized by the fact that a resin-coated transponder is embedded in part of the tire bead no more than 100 mm from the height of the rim flange in the radially outward direction of the tire, and that part of the resin-coated transponder is exposed in a recess in the tire bead surface.

2. The pneumatic tire of Claim 1, characterized by the fact that the above-mentioned transponder contains a cavity, which is exposed to a part recessed from the surface of the tire bead.

3. The pneumatic tire of Claim 1, characterized by the fact that the above-mentioned transponder contains a through-hole, which is directed toward the outer surface side of the tire bead.

4. The pneumatic tire of Claim 3, characterized by the fact that in the through-hole of the above-mentioned transponder, the outer surface side of the tire bead is greater than the inner surface side of the tire bead.

5. The pneumatic tire of any of Claims 1-4, characterized by the fact that part of the above-mentioned transponder is covered and retained by the side tread rubber.

6. A method for manufacturing a pneumatic tire, characterized by the fact that in exposing and embedding part of the resin-coated transponder with a cavity or through-hole in a recess in the surface of the tire bead, the cavity or through-hole of the above-mentioned transponder is fitted to a projection of the mold surface and disposed in advance; and an unvulcanized tire is inserted into the mold and vulcanized.

7. The method for manufacturing a pneumatic tire of Claim 6, characterized by the fact that the vulcanization is carried out with a mold with a projection that is fitted to the cavity or through-hole of the above-mentioned transponder and has a recess in which the side tread rubber is molded up to the depth of the above-mentioned projection height.

8. The method for manufacturing a pneumatic tire of Claim 6 or 7, characterized by the fact that the vulcanization is carried out with a mold with a projection higher than the depth of the cavity of the above-mentioned transponder or the through-hole of the tire bead surface.

9. The method for manufacturing a pneumatic tire of Claim 6 or 8, characterized by the fact that the vulcanization is carried out with a mold with a projection having a stopper part larger than the cavity or through-hole of the above-mentioned transponder.

10. The method for manufacturing a pneumatic tire of Claims 6-8 or 9, characterized by the fact that the vulcanization is carried out with a mold with several projections that fit to the cavity or through-hole of the above-mentioned transponder.

Detailed explanation of the invention

[0001]

Technical field of the invention

The present invention pertains to a pneumatic tire with embedded transponder and its manufacturing method. More specifically, the present invention pertains to a pneumatic tire with embedded transponder, which can reliably read and write the information of the transponder for

storing various information and has excellent robustness during vehicle traveling, and a reliable manufacturing method.

[0002]

Prior art

As shown in the schematic diagram of Figure 23, a technique for installing a transponder, which has both receiver and transmitter functions as well as a storage function, in a tire has been developed to control the manufacture of the tire by the tire-maker to monitor the tire usage history by the owner of the tire, or have access to such information as internal pressure and temperature of the tire. For example, in Japanese Kokai Utility Model Hei 2[1990]-123404, as shown in Figure 22, a structure is proposed for a tire which has two apexes located on the radially outward direction of an annular tension member of one bead, and the above-mentioned transponder is positioned between these two apexes, and prescribed effects are achieved.

[0003]

However, the position of the transponder installed in the tire with respect to the tire periphery could not be detected at all from the outside by observation with the naked eye, and in particular, when the vehicle stopped so that the transponder was positioned so that it faced the ground, it was difficult for radio waves from an interrogator to reach the transponder, making it necessary to move the vehicle again and take new measurements. Furthermore, since the glass-coated transponder was assembled into fitted parts of components of the tire before the tire was vulcanized, it was likely that the transponder would be moved by the rubber flow during vulcanization, so that it was necessary to control the rubber flow very precisely in order to fix the direction of the antenna with respect to the tire. Furthermore, during vehicle travel, the adhesive interface of the transponder and the peripheral rubber easily fractured due to tire deformation or heat generation, and there was always the risk that the transponder would become detached or that it would lose its communication ability.

[0004]

Problems to be solved by the invention

The purpose of the present invention is to provide a pneumatic tire with embedded transponder, which can reliably read, write, and store information, and which has excellent robustness during vehicle travel, and its manufacturing method.

[0005]

Means to solve the problems

According to the present invention, part of a resin-coated transponder having both receiver and transmitter functions as well as a storage function is exposed in a recess in the tire bead surface and embedded in the tire bead within 100 mm from the height of the rim flange in the radially outward direction of the tire. Thus, unlike the case in which the transponder is embedded in the tire tread, here the position of the transponder is externally visible. Also, since the location where the transponder is embedded can be simply specified by observation with the naked eye, the vehicle can be stopped at any desired position, and even if the tire is subject to a repeated bending deformation, since the transponder is embedded in the tire bead, which undergoes relatively little deformation, good reliability can be obtained.

[0006]

Also, according to the present invention, the above-mentioned transponder has a cavity, and the above-mentioned cavity is exposed to a part recessed from the surface of the tire bead. Thus, since the location of the transponder can be confirmed by observation with the naked eye, its distance from the interrogator is considerably reduced, so that there is no concern of read or write error.

[0007]

Also, according to the present invention, the above-mentioned transponder has a through-hole, and the above-mentioned through-hole is directed toward the surface side of the tire bead and is embedded in the tire bead. Thus, since its distance from the interrogator is reduced, there is no concern of read and write errors, and since the side tread rubber is molded in the through-hole part of the transponder, which is embedded in the tire bead, the concern that the transponder will fall out is reduced.

[0008]

Also, according to the present invention, in the through-hole of the above-mentioned transponder, the surface side of the tire bead is greater than the inner surface side of the tire bead. Thus, since the side tread rubber molded into the through-hole part extends to the surface side of the tire bead and is embedded in the tire, there is no concern that the transponder will fall out.

[0009]

Also, according to the present invention, part of the above-mentioned transponder is covered and retained by the side tread rubber. Thus, even if there is interference to the tire such

as from a curb, the direct influence of the external force on the transponder is small, and the robustness of the transponder during vehicle travel is excellent.

[0010]

Also, according to the present invention, in exposing and embedding a resin-coated transponder with a cavity or through-hole in a recess in the surface of part of a tire bead, the cavity or through-hole of the above-mentioned transponder is fitted to a projection of a mold surface and disposed in advance, and the unvulcanized tire is inserted into the mold and vulcanized. Thus, the recess in the surface of the tire bead is formed, and even if the flow of rubber during vulcanization is high, the transponder can be held by the projection, so that the transponder can be precisely installed at the desired position. Thus, the antenna direction with respect to the tire can be fixed.

[0011]

Also, according to the present invention, the vulcanization is carried out with a mold with a projection that is fitted to the cavity or through-hole of the above-mentioned transponder and has a recess in which the side tread rubber is molded up to the depth of the above-mentioned projection height. Thus, since the side tread rubber is molded to the recess with the projection that goes through the through-hole in the transponder and extends into the recess and holds the transponder like a buttonhook, there is no concern that the transponder will peel off or fall out.

[0012]

Also, according to the present invention, the vulcanization is carried out with a mold with a projection higher than the depth of the cavity in the above-mentioned tire bead surface or the through-hole in the transponder. Thus, the tire side tread rubber is vulcanized while holding the transponder as much as the portion in which the mold projection height exceeds the depth of the cavity or through-hole on the surface of the tire bead. In other words, the embedded depth of the transponder can be freely adjusted by creating a difference in the depth of the above-mentioned cavity or through-hole on the surface side of the tire bead and the projection height of the mold.

[0013]

Also, according to the present invention, the vulcanization is carried out with a mold with a projection having a stopper part larger than the cavity or through-hole of the above-mentioned transponder. Thus, the recess in the surface of the tire bead is formed, and the transponder can be prevented from moving during vulcanization of the tire, so that the embedded depth of the transponder can be freely adjusted.

[0014]

Also, according to the present invention, the vulcanization is carried out with a mold with several projections that fit the cavity or through-hole of the above-mentioned transponder. Thus, the recess in the surface of the tire bead is formed, and the tire side tread rubber is molded into the projection and can hold the transponder securely.

[0015]

Embodiments of the invention

The present invention will now be explained with reference to application examples illustrated by figures. Needless to say, the scope of the claims of the present invention is not limited by these application examples. Figure 1 is a half cross section showing the tire with embedded resin-coated transponder with a cavity, and an enlarged cross section of the transponder embedded part. 1 is the cap tread, 2 is the belt, 3 is the side tread, 4 is thread carcass cord, 5 is the bead wire, 6 is the finishing, 7 is the transponder, 8 is the bead part, and 11 is the tire. The state in which the cavity 7a of the resin-coated transponder 7 is exposed in recess 8a in the tire bead surface a is shown. Also, in the following figures, some of these same symbols related to the tire are partially omitted.

[0016]

An enlarged cross section of the transponder embedded part is shown in a cross section A-A of Figure 2, and the state in which the transponder 7 with a cavity is embedded in the tire while orienting the cavity 7a toward the tire bead surface is shown. In this manner, unlike the case in which the transponder is completely embedded in the tire, the cavity 7a of the transponder 7 remains in the recess 8a in the surface of the tire bead, and the location where the transponder 7 is embedded can be ascertained simply by observation with the naked eye. Thus, since a vehicle can be stopped at any desired position, and the distance from an interrogator (not shown in the figure) can be reduced during communication, there is no concern that reading and writing will be compromised.

[0017]

Also, the difference between the cavity depth of the transponder and the projection height of the mold, that is, the side tread rubber coating thickness B for holding the transponder may be 0.5-3 mm, preferably 1-2 mm. If the thickness is less than 0.5 mm, the protective effect is slight, and if the thickness is greater than 3 mm, poor rubber flow may result during vulcanization, which is undesirable.

[0018]

Also, the shape of the transponder 7 is not limited to that of a rectangular plate, but may be any appropriate shape, such as hexagonal or disk-shaped. The shapes of the projection 9 of the mold and the cavity 7a or through-hole 7b of the transponder 7 may also be appropriately selected as long as they can be fitted to each other. Also, the resin for the transponder of the present invention is not particularly limited as long as it is heat-resistant during vulcanization of the tire, and for example, an epoxy resin with heat resistance and having a melting point or thermal decomposition temperature of 200°C or higher may be used. Also, the disclosure of the present invention includes the case in which a rubber sheet of 0.5 mm or less, which is a so-called overflow, covers the transponder on the surface of the above-mentioned cavity or through-hole.

[0019]

Figure 2 is a half cross section showing a mold in which the resin-coated transponder 7 with cavity 7a of the present invention is inserted into the projection 9 of the mold for manufacture, and an enlarged diagram showing a state in which the transponder is fitted to the projection 9 of the mold above said cavity depth. Therefore, the transponder 7 can be embedded so that it may be held by the side tread rubber. Thus, the transponder 7 holds up well during travel, and is not directly influenced by outside interference, such as from curbs. Thus, problems that result from fracture can be suppressed.

[0020]

Figure 3 is a half cross section showing the mold in which the projection 9 of the mold for fitting the transponder of the present invention is installed and an enlarged oblique view showing the projecting portion of the mold. In this manner, the recess 8a in the surface of the tire head part is formed, and the transponder 7 is not moved by the rubber flow during tire vulcanization, so that good communication characteristics can be expected.

[0021]

Figure 4 shows front and back oblique views of the resin-coated transponder 7 with cavity of the present invention. The above-mentioned cavity 7a is directed toward the surface side of the tire bead, and the transponder is embedded in the tire bead. Thus, since the transponder 7 can be embedded so that it is retained by the side tread rubber, it holds up well during travel, and the transponder 7 is not directly affected by outside interference, such as from curbs. Thus problems that result from fracture can be suppressed. Also, the shape of the cavity 7a of the transponder 7 is not limited to rectangular, but may be any appropriate shape, such as

hexagonal or circular. The shapes of the projection 9 of the mold and the cavity 7a or through-hole 7b of the transponder 7 may also be appropriately selected as long as they can be fitted to each other.

[0022]

Figure 5 is an oblique view showing the tire 11, and indicates the position where the resin-coated transponder 7 of the present invention is embedded. Since the cavity 7a of the transponder 7 is installed in the recess 8a in the surface of the tire bead, the position of the transponder 7 can be detected by observation with the naked eye, so that reliable reading and writing are made possible by contacting the interrogator to said position.

[0023]

Figure 6 is a half cross section of the tire showing the position relation of the resin-coated transponder of the present invention and in relation to the rim. If the height from the rim flange height H to the center of the transponder is A, if A is up to 100 mm, preferably 70 mm or less, good robustness during vehicle travel can be obtained. If the height exceeds 100 mm, the transponder is too close to the outside of the tire, so that the distortion from a loaded vehicle during travel is increased. Thus, the transponder is apt to peel off or fall, which is undesirable. Also, since the outer periphery of the transponder 7 does not make contact with the rim during loaded vehicle travel, it is desirable to keep the transponder from the rim flange height H by at least 10 mm, preferably 20 mm or more.

[0024]

Figure 7 is a partial cross section of the tire in which the resin-coated transponder 7 with through-hole 7b of the present invention is embedded in the tire bead 8. In this manner, unlike the case in which the transponder is embedded in the tire, since the location of the transponder 7 is easily discernible and the position where the transponder 7 is embedded can be simply seen by observation with the naked eye, the vehicle can be stopped in any desired position.

[0025]

Figure 8 is a partial oblique view showing the state in which the resin-coated transponder 7 with the through-hole 7b of the present invention is embedded in the projection 9 of the mold. Since the transponder 7 is fitted to the projection of a mold with a stopper part 9a larger than the through-hole 7b of the surface side of the tire bead, the periphery of the transponder 7 is covered as much as the thickness of the stopper part 9a by the tire side tread rubber, and good robustness can be maintained.

[0026]

Figure 9 is a partial oblique view showing the projection 9 of a mold which has a central projection part fitted to the transponder 7 and the stopper part 9a larger than the through-hole 7b. The recess in the surface of the tire bead is formed, and the transponder 7 does not shift position due to the rubber flow during tire vulcanization, so that good communication can be expected.

[0027]

Figure 10 shows the front and back of the resin-coated transponder 7 with the through-hole 7b of the present invention. In this manner, the side tread rubber is molded into the through-hole 7b of the transponder 7, and the transponder 7 can also be embedded from the inside with applied pressure.

[0028]

Figure 11 is a partially enlarged oblique view showing the position where the transponder of an application example of the present invention is embedded. The resin-coated transponder 7 with the through-hole 7b is embedded in the recess 8a in the tire bead surface. Thus, it is understood that the position of the transponder 7 can be detected by observation with the naked eye and the transponder 7 is protected by the molded side tread rubber 3a.

[0029]

Figure 12 is a partial cross section showing another tire in which the resin-coated transponder 7 with a through-hole 7c on the outside surface side of the tire bead and a through-hole 7d on the inner surface side of the tire of the present invention. The through-hole 7c on the outer surface side of the tire bead is larger than the through-hole 7d on the inner surface side of the tire, and the transponder is embedded by as much as the difference between the height of the mold projection 9 and the depth of the through-hole 7c on the surface side of the tire bead in the tire bead. In this manner, unlike the case in which the transponder is embedded in the tire, since there is no concern that the location of the transponder 7 is not easily discernible and the position where the transponder 7 is embedded can be simply seen by observation with the naked eye, the vehicle can be stopped so that the transponder 7 may be set at a reliable communication position with an interrogator (not shown in the figure.)

[0030]

Also, the difference between the depth of the through-hole 7c on the surface side of the tire bead and the height of the mold projection 9, that is, the side tread rubber coating thickness B for holding the transponder 7 may be 0.5-3 mm, preferably 1-2 mm. If the thickness is less than

0.5 mm, the protective effect is slight, and if the thickness is greater than 3 mm, poor rubber flow will likely result during vulcanization, which is undesirable.

[0031]

Figure 13 is a partial oblique view showing the state in which the resin-coated transponder 7 with through-hole 7c on the surface side of the tire bead and the through-hole 7d on the inner surface side of the tire is inserted into the mold projection 9. Since the transponder 7 is fitted to the mold projection 9 above the depth of the through-hole 7c on the surface side of the tire bead, the transponder is not moved by the rubber flow during tire vulcanization; and since the periphery of the transponder 7 is covered by the tire side tread rubber, good robustness can be maintained. Furthermore, since the through-hole 7d is formed in the central part of the mold projection, the side tread rubber is also molded into the transponder, and the retaining force of the tire tread rubber on the transponder is reinforced.

[0032]

Figure 14 is a partial oblique view showing the state in which a recess 9b is formed in the mold projection 9 for fitting the transponder. Since the recess 8a in the surface of the tire bead is formed and the side tread rubber extends and fills in the recess 9b of the mold projection 9 through the through-hole 7d of the transponder 7, the transponder 7 is firmly held like a buttonhook, so that improved robustness can be effected.

[0033]

Figure 15 is front and back oblique views showing the resin-coated transponder of the present invention in which the through-hole 7c on the surface side of the tire bead is larger than the through-hole 7d on the inner surface side of the tire. In this manner, since the side tread rubber is molded and extends into the through-hole 7c of the transponder 7 on the surface side of the tire bead, the transponder 7 is firmly held like a buttonhook, so that improved robustness can be effected.

[0034]

Figure 16 is a partially enlarged oblique view showing the position where the transponder of an application example of the present invention is embedded. Since the recess 8a in the surface of the tire bead has the through-hole 7c on the outer surface side of the tire bead coated with resin and the side tread rubber 3a is molded into the through-hole 7c, the position of the transponder 7 can be detected by observation with the naked eye.

[0035]

Figure 17 is a cross section showing two positions of another tire into which the resin-coated transponder with the through-hole 7c on the outer surface side of the tire bead and the through-hole 7d on the inner surface side of the tire of the present invention is embedded. In this manner, since the transponder 7 is partially held by the side tread rubber, it can be retained securely, and since the position where the transponder is embedded can be simply specified from the outside of the tire by observation with the naked eye, the vehicle can be stopped in any desired position.

[0036]

Figure 18 is a partial oblique view showing the state in which the resin-coated transponder 7 of the present invention with the through-hole 7c on the outer surface side of the tire bead and the through-hole 7d on the inner surface side of the tire is inserted into the mold projection 9. Since the transponder 7 is fitted to several projections 9c of a mold above the depth of the through-hole 7c on the surface side of the tire bead, the transponder 7 does not move from the rubber flow during tire vulcanization, and since the periphery and top of the transponder 7 are covered with the tire side tread rubber, good robustness can be maintained. Furthermore, since several mold projections are installed and the central part is empty, the tire side tread rubber is molded into it, and the retaining force from the tire side tread rubber on transponder 7 is further strengthened.

[0037]

Figure 19 is a partial oblique view showing a mold in which several projections 9c are installed at four corners for fitting to the transponder 7. Since the recess 8a in the surface of the tire bead is formed and the tire side tread rubber securely holds the transponder 7 from four directions better robustness can be maintained. Also, needless to say, the arrangement of several projections 9c may be that of an arbitrary number of pieces, shapes, etc., as long as they can fit the transponder 7.

[0038]

Figure 20 shows front and back oblique views of the resin-coated transponder 7 of the present invention in which the through-hole 7c on the outer surface side of the tire bead is larger than the through-hole 7d on the inner surface side of the tire. Since, in this way, the side tread rubber is molded into the through-hole 7c of the transponder 7 on the surface side of the tire bead and the transponder 7 is firmly held like a buttonhook, better robustness can be maintained.

[0039]

Figure 21 is a partially enlarged oblique view showing the position where the transponder is embedded in an application example of the present invention. It is understood that since the through-hole 7c of the resin-coated transponder 7 on the surface side of the tire bead in the recess 8a in the surface of the tire bead and the side tread rubber 3a molded into the through-hole 7c extend in a cruciform shape, the position of the transponder 7 can be simply confirmed by observation with the naked eye and the transponder 7 can be very firmly held.

[0040]

Application examples

A square transponder with a length and width of 23 mm and a thickness of 3 mm coated with a bisphenol A type epoxy resin with a Shore D hardness of 96 measured according to JIS 6301 standards and an initial decomposition temperature of 300°C, in which a cavity with a depth of 1.5 mm and a diameter of 5 mm was installed at the center described in Figures 1-5 was used. Three types of tires were prototyped for of the case (1) in which a columnar projection 9 with a height of 3 mm and a diameter of 5 mm was installed at the mold position corresponding to 40 mm from the rim flange an 11R22.5 16 PR tire for travel on a typical paved road and the above-mentioned transponder was embedded in the tire as shown in Figure 1 of the present invention, the case (2) in which the same transponder was flipped over and embedded in the position with the same height as the mold surface without using a projection, and the case (3) in which a columnar mold projection 9 with a height of 3 mm and a diameter of 5 mm was installed in the mold position corresponding to 110 mm from the rim flange was installed and the transponder was embedded therein. The case (4) in which the conventional transponder of Figure 23 was embedded in a tire as shown in Figure 22 was assumed the conventional example of the prior art. An indoor drum robustness test was carried out.

[0041]

The test conditions, referenced to JATMA 1999, included use of a standard 22.5 x 8.25 rim, a load of 26.72 kN, air pressure at 700 kPa, and speed of 60 km/h. The travel time until the transponder of the conventional example (4) could not communicate was assumed to be 100 [units].

[0042]

(Table I)

	1 走行時間（指数）	2 故障内容
3 (1) 本発明	200	タイヤ故障により中止 7
4 (2) 比較例	80	タイヤ表面に亀裂発生し中止 8
5 (3) 比較例	60	トランスポンダ通信不能 9
6 (4) 従来例	100	トランスポンダ通信不能 10

Key:
1 Travel time (index)
2 Problem
3 (1) Present invention
4 (2) Comparative example
5 (3) Comparative example
6 (4) Conventional example
7 Stop due to tire trouble
8 Stop due to generation of cracks on the tire surface
9 Transponder unable to communicate
10 Transponder unable to communicate

The results are shown in Table I, from which it is clear that the robustness of the transponder (1) of the present invention is excellent. Furthermore, when a hole with a depth of 1.5 mm and a diameter of 5 mm exists on the tire surface and an interrogator is in direct contact with it, the distance from the transponder can be minimized. Thus, it is easily understood that it is not necessary to search for the position where the transponder is embedded in the tire periphery, unlike the conventional example.

[0043]

Effect of the invention

According to the present invention, a pneumatic tire with embedded transponder, which can reliably read, write, and store the information and have excellent robustness during vehicle travel, and its manufacturing method can be provided.

Brief description of the figures

Figure 1 is a half cross section showing an application example of the present invention and an enlarged cross section showing a detail of the section with transponder.

Figure 2 is a half cross section showing a mold in which the transponder is inserted into a projection of a mold for manufacture in the application example of the present invention and a partially enlarged oblique view showing the insertion part.

Figure 3 is a half cross section showing the mold for manufacture in the application example of the present invention and an enlarged oblique view showing the projection part.

Figure 4 shows front and back oblique views of the embedded transponder in the application example of the present invention.

Figure 5 is an oblique view of the tire, indicating the position of the embedded transponder in an application example of the present invention.

Figure 6 is a half cross section of the tire, indicating the positional relationship of the embedded transponder and rim.

Figure 7 is a cross section showing the transponder section in another application example of the present invention.

Figure 8 is a partial oblique view showing the state in which the transponder is inserted into the projection of the mold for manufacture in another application example of the present invention.

Figure 9 is an oblique view showing the projection part of the mold for manufacture in another application example of the present invention.

Figure 10 shows front and back oblique views of the embedded transponder in another application example of the present invention.

Figure 11 is a partially enlarged oblique view of the embedded transponder in another application example of the present invention.

Figure 12 is a cross section showing the transponder section in another application example of the present invention.

Figure 13 is a partial oblique view showing the state in which the transponder is inserted into the projection of the mold for manufacture in another application example of the present invention.

Figure 14 is an oblique view showing the projection part of the mold for manufacture in another application example of the present invention.

Figure 15 shows front and back oblique views of the embedded transponder in another application example of the present invention.

Figure 16 is a partially enlarged oblique view of the embedded transponder in another application example of the present invention.

Figure 17 is a cross section showing two positions of the transponder section in another application example of the present invention.

Figure 18 is a partial oblique view showing the state in which the transponder is inserted into the projection of the mold for manufacture in another application example of the present invention.

Figure 19 is an oblique view showing the projection part of the mold for manufacture in another application example of the present invention.

Figure 20 is an oblique view of the embedded transponder in another application example of the present invention.

Figure 21 is a partially enlarged oblique view of the embedded transponder in another application example of the present invention.

Figure 22 shows the arrangement of a transponder in a conventional tire.

Figure 23 is a schematic diagram showing a conventional transponder.

Explanation of reference symbols

1	Cap tread
2	Belt
3	Side tread
3a	Molded side tread rubber
4	Carcass cord
5	Bead wire
6	Finishing
7	Transponder
7a	Cavity
7b	Through-hole
7c	Through-hole on the outer surface of tire bead
7d	Through-hole on the inner outer surface of tire
8	Bead part
8a	Recess in tire bead surface
9	Projection of mold
9a	Stopper part
9b	Recess
9c	Several projections
10	Conventional transponder
11	Tire
A	Height from level of the rim flange to the center of the transponder
H	Rim flange height
B	Coating thickness

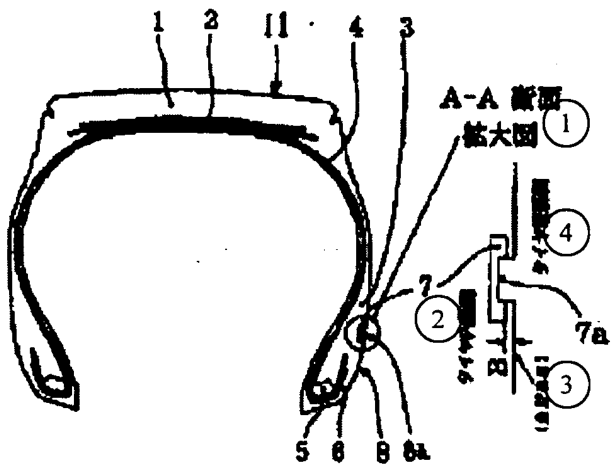


Figure 1

Key: 1 Enlarged detail of cross section A-A
2 Inner surface of tire
3 Mold surface
4 Outer surface of tire

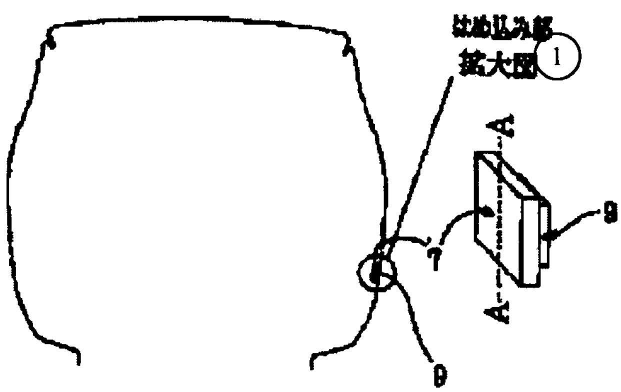


Figure 2

Key: 1 Enlarged detail of insertion part

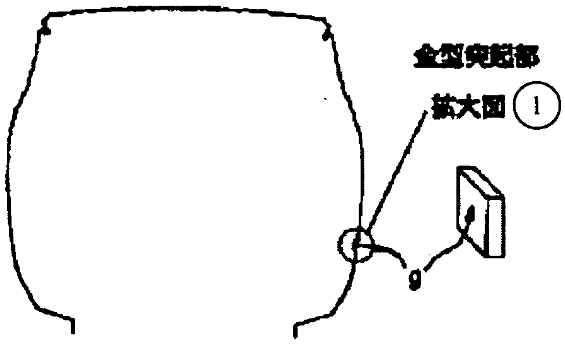


Figure 3

Key: 1 Enlarged detail of mold projection part

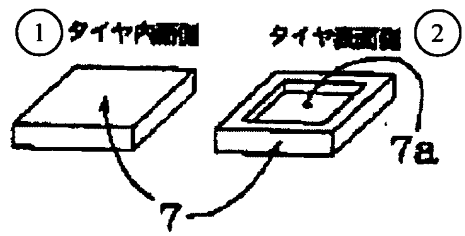


Figure 4

Key: 1 Inner surface of tire
2 Outer surface of tire

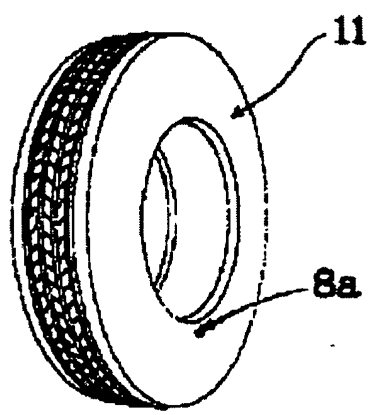


Figure 5

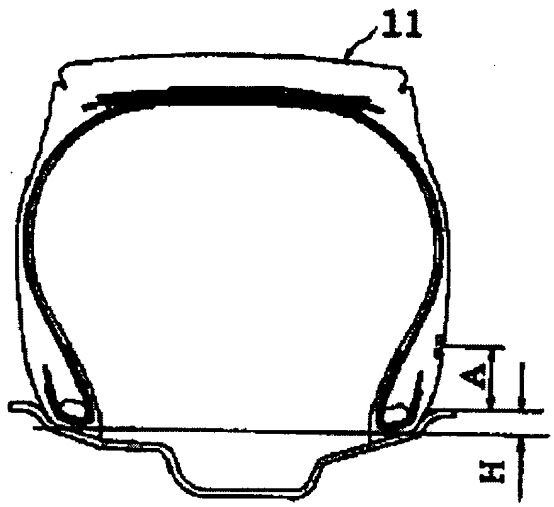


Figure 6

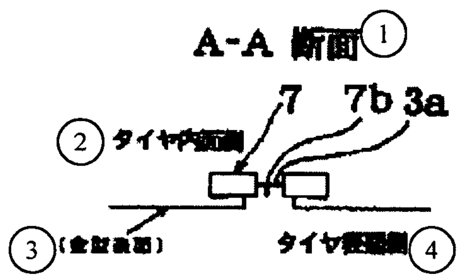


Figure 7

Key: 1 Cross section A-A
2 Inner surface of tire
3 Mold surface
4 Outer surface of tire

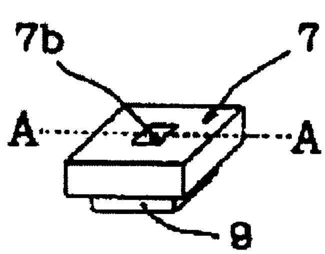


Figure 8

Figure 9

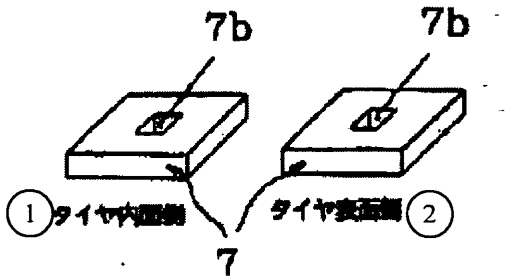


Figure 10

Key: 1 Inner surface of tire
2 Outer surface of tire

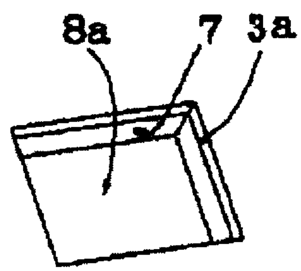


Figure 11

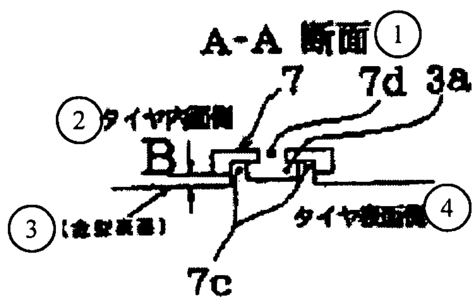


Figure 12

Key: 1 Cross section A-A
2 Inner surface of tire
3 Mold surface
4 Outer surface of tire

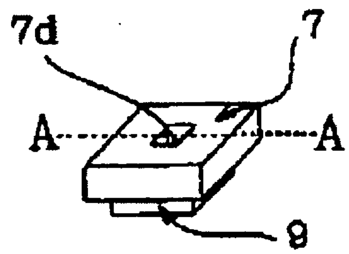


Figure 13

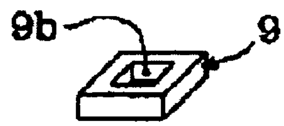


Figure 14

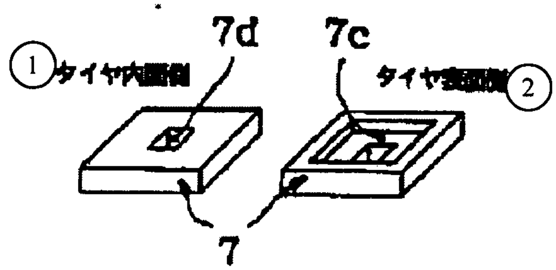


Figure 15

Key: 1 Inner surface of tire
2 Outer surface of tire

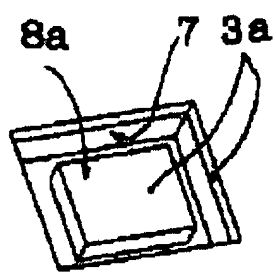


Figure 16

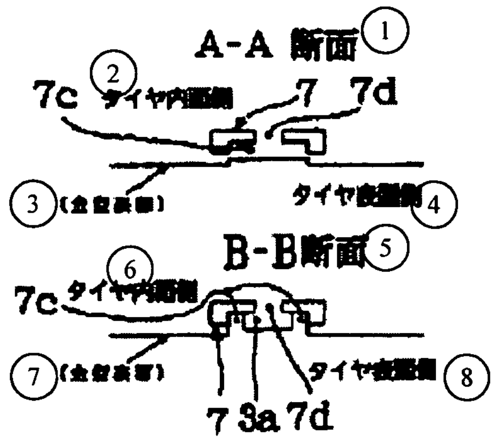


Figure 17

Key:
1 Cross section A-A
2 Inner surface of tire
3 Mold surface
4 Outer surface of tire
5 Cross section B-B
6 Inner surface of tire
7 Mold surface
8 Outer surface of tire

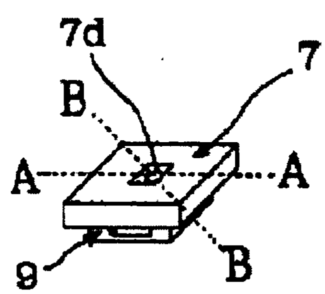


Figure 18

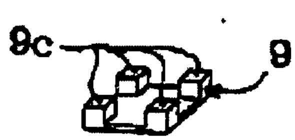


Figure 19

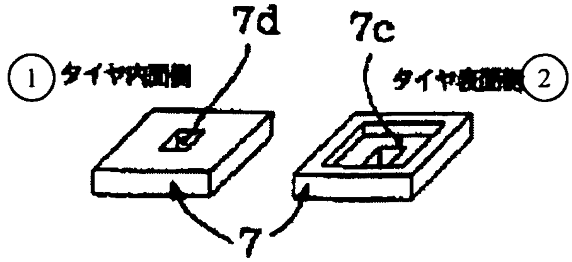


Figure 20

Key: 1 Inner surface of tire
2 Outer surface of tire

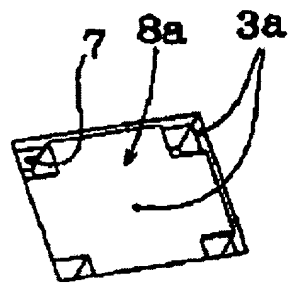


Figure 21

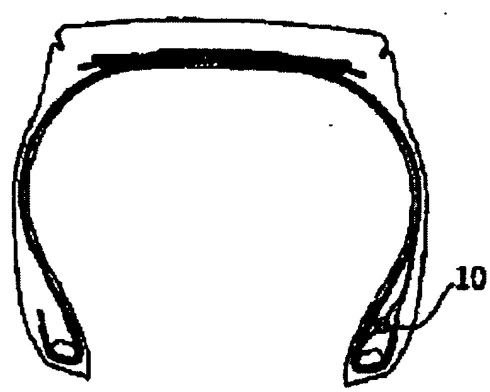


Figure 22

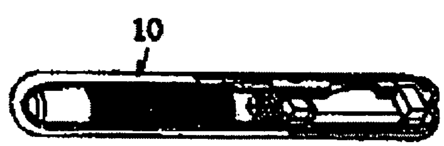


Figure 23